14.67, p618

$$I_2(g) + Br_2(g) \rightleftharpoons 2\,IBr(g) \quad K_c = 120$$

Find the equilibrium composition at 150C if a 5.0 L vessel initially contains 0.0015 mol (each) of iodine and bromine

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$$K_c = \frac{[IBr]^2}{[I_2][Br_2]} = 120$$

We need to express everything here in terms of one variable

Species	[Initial]	Δ	[Equilibrium]
IBr	0	$+2x$	$2x$
I_2	$\frac{0.0015\,mol}{5.00\,L} = 3\times10^{-4}$	$-x$	$3\times10^{-4} - x$
Br_2	$\frac{0.0015\,mol}{5.00\,L} = 3\times10^{-4}$	$-x$	$3\times10^{-4} - x$

$$120 = \frac{[IBr]^2}{[I_2][Br_2]} = \frac{(2x)^2}{(0.0003-x)(0.0003-x)}$$

$$\frac{(2x)^2}{(0.0003-x)^2} = 120$$

$$\sqrt{\frac{(2x)^2}{(0.0003-x)^2}} = \sqrt{120}$$

$$\frac{2x}{0.0003-x} = 10.95445115$$

$$2x = 0.003286333 - 10.95445115x$$

$$12.95445115x = 0.003286333$$

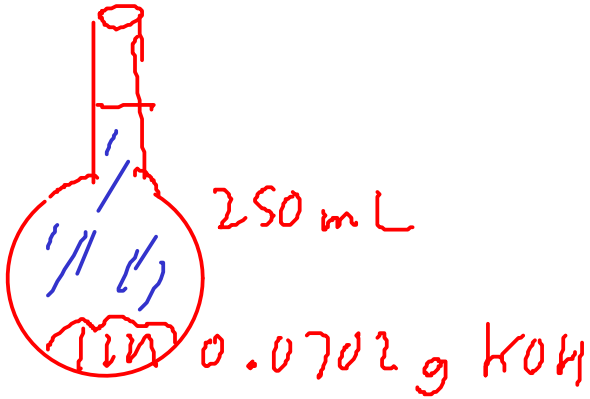
$$x = 2.5368 \times 10^{-4}$$

Species	[Initial]	Δ	[Equilibrium]
IBr	0	$+2x$	$2x$
I_2	$\frac{0.001\,5\text{mol}}{5.00\text{L}} = 3\times10^{-4}$	$-x$	$3\times10^{-4} - x$
Br_2	$\frac{0.001\,5\text{mol}}{5.00\text{L}} = 3\times10^{-4}$	$-x$	$3\times10^{-4} - x$

$$[IBr] = 2(2.5368\times10^{-4})$$
$$= 5.1\times10^{-4}\ M$$

$$[I_2] = [Br_2] = 3\times10^{-4} - 2.5368\times10^{-4}$$
$$= 4.6\times10^{-5}\ M$$

Calculate the pH of a solution made by dissolving 0.0702 grams of the strong base potassium hydroxide, KOH, in enough water to make 250. mL of solution?



$$pH = -\log [H_3O^+]$$

$$H_2O + H_2O \rightleftharpoons H_3O^+ + OH^-$$

$$K_w = 1.0 \times 10^{-14} = [H_3O^+][OH^-]$$

Since $KOH \rightarrow K^+ + OH^-$, we need to know $[KOH]_{nominal}$ to find $[OH^-]$

$$0.0702\ g\ KOH \times \frac{mol\ KOH}{56.1056\ g\ KOH} \times \frac{}{0.250\ L} = 0.005004848\ M$$

$$[KOH]_{nominal} = [OH^-] = 0.005004848\ M$$

$$[H_3O^+](0.005004848\ M) = 1.0 \times 10^{-14}$$

$$[H_3O^+] = 1.998 \times 10^{-12}$$

$$pH = \boxed{11.70}$$